



## GAMING MACHINE

## Field of Technology

[0001] This invention relates to a gaming machine comprising an electric image display device.

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## Description of Related Art

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[0002] Conventionally, this type of gaming machine includes a slot machine. When playing a slot machine, three reels embedded behind the front panel thereof rotates so that the symbols drawn on the outer periphery of each reel are variably displayed one after another through the three reel windows formed in the front panel. When the reels stops rotating and the symbols displayed on the respective windows correspond to a predetermined combination, then the game is won, and medals won are paid out.

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[0003] There exists a conventional slot machine comprising a liquid crystal display device provided on the front panel at the lower side of the reel windows, serving as an electric display device for displaying effect images and information images relating to an ongoing game (refer to Patent Document 1). There also exists a conventional slot machine comprising a liquid crystal display device with a large display area provided on the front panel, serving as an electric display device. Such display devices comprise a light guiding plate disposed at the rear side of the

liquid crystal display panel, and illumination devices constituted by a cold-cathode tube are disposed at the sides of the upper and lower ends of the light guiding plate. The illumination light emitted from the cold-cathode tube enters the light guiding plate from the upper and lower side faces of the light guiding plate to subsequently emit toward the rear side of the liquid crystal panel via a lens cut formed within the light guiding plate. The liquid crystal display panel is illuminated with the emitted light.

[0004] Refer to Japanese Patent Laid-open Publication No. 2002-78856, for example.

#### Summary of the Invention

[0005] However, the conventional slot machine using a cold-cathode tube as an illumination device for illuminating a liquid crystal display panel shows variations in voltage applied to the cold-cathode tube among respective gaming machines due to the coil loss of the transformer used to allow the cold-cathode tube to be on, resulting in variations in brightness for illuminating the liquid crystal display panel among respective gaming machines. Further, the conventional slot machines described above require an inverter circuit to avoid flickers in the illumination. However, an image displayed on a liquid crystal panel

could be disturbed by the noise generated from the inverter circuit.

[0006] In a conventional slot machine using a cold-cathode tube as illumination means, the increase of the size of its liquid crystal panel necessitates the corresponding increase of an amount of illumination light by the illumination means. However, when the number of cold-cathode tubes is increased to increase an amount of the illumination light, the space for disposing the cold-cathode tubes must be extended in the direction of the thickness of the light guiding plate. Therefore, the thickness of the light guiding plate also must accordingly be increased, resulting in growing in size of an electric display device. In addition, the increase of the thickness of the light guiding plate entails the corresponding increase of the distance between the reel and the liquid crystal panel. Accordingly, in a conventional slot machine equipped with a large size liquid crystal panel, when effect such as overlaying a liquid crystal image on a symbol on the reel is performed, significant displacement may occur between the symbol drawn on an outer periphery of the reel and an image displayed on the liquid crystal panel depending on a player's viewing angle, thereby impairing the effect.

[0007] To solve these problems, this invention provides a slot machine comprising: variable display means for variably displaying symbols; and an electric display device disposed in front of the variable display means, and having a light transparent area which shows symbols displayed on the variable display means, from outside of the gaming machine, herein said electric display device includes; n electric display panel displaying an image and illumination means having a light emitting diode, the illumination means illuminating the electric display panel from therebehind.

[0008] According to this configuration, the electric display panel is illuminated by LEDs so that the image displayed on the electric display panel will be visible. Since LEDs are lighted merely through application of DC current, an inverter circuit is not necessary. Further, since no transformer is required to light LEDs, variations in voltage applied to an illumination means among respective gaming machines due to the coil loss can be avoided. Moreover, the brightness of the illumination can be easily adjusted merely by adjusting the amount of current supplied to the LED with variable resistance or the like.

[0009] Furthermore, in this invention, an electric display means may be arranged such that the

electric display device may comprise a light guiding plate that guides light entered from a side face thereof, to a back face of the electric display device, so as to irradiate the light; and the illumination means may comprises a plurality of the light emitting diodes, each of which is continuously aligned along a side face of the light guiding plate.

[0010] According to this configuration, it is possible to adjust the amount of illumination light emitted from the illumination means by adjusting the amount of current to be supplied to each of the arrayed LEDs or by increasing/decreasing the number of LEDs to be supplied with current.

[0011] Further, in this invention, the illumination means may be configured such that the illumination means comprises a plurality of the light emitting diode provided in matrix on an entire surface of the electric display device excluding the light transmitting area, the light emitting diodes opposing a back face of the electric display device.

[0012] According to this configuration, since the light emitted from the LEDs illuminates directly the electric display panel, it is possible to illuminate the electric display panel without using a light guiding plate. Further, it is possible to adjust the amount of light emitted from the illumination means

over a wide range by increasing/decreasing the amount of current supplied to each of the plural LEDs arranged over one surface of a plate-shaped member. Therefore, it is possible to significantly increase the amount of light emission while maintaining the thickness of the illumination means constant so that even when the size of the electric display panel is large, the distance between the variable display means and the electric display panel can be maintained constant. Further, it is possible to selectively illuminate a specified area in the electric display panel or adjust the brightness of a specified area by selecting the area of the LEDs to be on from those arrayed in a matrix or by adjusting the amount of current supplied to the LEDs within a specified area, respectively.

#### Brief Description of the Drawings

[Fig. 1]

This is a front view of an appearance of a slot machine in accordance with a first embodiment of this invention;

[Fig. 2]

This is a view of a state in which pay lines indicated on a display window of the slot machine in accordance with the first embodiment of this invention are sequentially activated;

[Fig. 3]

This is a vertical cross-sectional view of a reel display window unit of the slot machine in accordance with the first embodiment of this invention;

[Fig. 4]

5 This is an exploded perspective view of the reel display window unit shown in Fig. 3;

[Fig. 5]

This is an enlarged perspective view schematically showing a structure of the illumination device shown in Fig. 4;

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[Fig. 6]

This is a view of symbols drawn on the outer periphery of the reels of the slot machine in accordance with the first embodiment of this invention;

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[Fig. 7]

This is a perspective view of a rotational reel unit of the slot machine in accordance with the first embodiment of this invention;

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[Fig. 8]

This is a perspective view of structure of the rotational reel constituting the rotational reel unit shown in Fig. 7;

[Fig. 9]

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This is a view of symbol combinations drawn on a dividend display unit of the slot machine in

accordance with the first embodiment of this invention;

[Fig. 10]

5 This is a block diagram of a circuit configuration arranged on a main control board of the slot machine in accordance with the first embodiment of this invention;

[Fig. 11]

10 This is a block diagram showing a circuit configuration arranged on a sub-control board of the slot machine in accordance with the first embodiment of this invention;

[Fig. 12]

15 This is a vertical cross-sectional view of a reel display window unit of the slot machine in accordance with a second embodiment of this invention;

[Fig. 13]

This is an exploded perspective view of the reel display window unit shown in Fig. 12; and

20 [Fig. 14]

This is an enlarged perspective view schematically showing a structure of the illumination device shown in Fig. 13.

#### Detailed Description of the Invention

25 [0013] The description will now be given about a first embodiment in which a gaming machine according



to this invention is applied to a slot machine.

[0014] Fig. 1 is a front view showing an appearance of a slot machine 1 according to the embodiment.

[0015] Inside a cabinet at the center of the main  
5 body of a slot machine 1, three reels 2, 3 and 4 are  
rotatably provided. These reels 2, 3 and 4 constitute  
a variable display means for variably displaying  
various symbols used for a game. On the outer  
10 periphery of each of reels 2, 3 and 4, a line of symbols  
consisting of a plurality of kinds of symbols  
(hereinafter referred to as symbols) are drawn. A  
reel display window unit 39 is provided in front of  
the respective reels 2-4. Through respective display  
15 windows 5, 6 and 7 defined in the reel display window  
unit 39, respective three symbols among those drawn  
on the outer periphery of the corresponding reels 2,  
3 and 4 can be seen. On the reel display window unit  
39, a total of five pay lines are provided, three of  
which are horizontal and the remaining two diagonal.  
20 Below the display windows 5-7, on the right side, an  
insertion slot 8 is provided through which a player  
inserts one or more medals, the medal serving as a  
gaming medium.

[0016] When a player inserts a medal into the medal  
25 insertion slot 8 prior to start a game, one horizontal  
center pay line L1 is activated as shown in Fig. 2 (a).

When two medals are inserted, two upper and lower horizontal pay lines L2A and L2B are added to enable a total of three horizontal pay lines L1, L2A and L2B as shown in Fig. 2(b). When three medals are inserted,  
5 all the five pay lines L1, L2A, L2B, L3A and L4B are activated as shown in Fig. 2 (c). Each circle sign shown in these figures represents a symbol drawn on the reels 2-4.

[0017] On an machine front panel 38 to the left  
10 of the display windows 5-7, there are provided a symbol combination continuous actuation enhancer indicator 9, a symbol combination continuous actuation enhancer indicator 10, a replay indicator 11, a game stop indicator 12, three gaming medal insertion number  
15 indicator lamps 13-15, a deposition amount display unit 16, and a start lamp 17. Each of the indicators 9-12 and the gaming medal insertion number indicator lamps is controlled to be on in accordance with the state of the ongoing game, thereby informing a player  
20 of the state of the ongoing game and the number of inserted medals. The deposition amount display unit 16 is composed of three digits of 7-segment LEDs (light emitting diodes) and displays the number of medals currently credited within the machine. The start  
25 lamp 17 blinks when the reels 2-4 can be started.

[0018] On the machine front panel 38 to the right

of the display windows 5-7, there are provided a bonus count display unit 18, a WIN lamp 19, a payoff amount display unit 20 and an insertion lamp 21, positioned from the top in this order. The bonus count display unit 18 is composed of three digits of 7-segment LEDs and digitally displays, when a player wins a bonus game, the remaining number of times for possibly winning at an RB and JAC games. The WIN lamp 19 is lighted when symbols of a winning combination appear on an activated pay line. The payoff amount display unit 20 is composed of three digits of 7-segment LEDs and displays the number of medals to be paid out when a game is won. The insertion lamp 21 is lighted when the medal insertion slot 8 can receive a medal.

[0019] The reel display window unit 39 comprises a liquid crystal display panel 39d (described later) laminated thereon as an electric display panel. The liquid crystal panel 39d can display various game information and game effect images. At the left-hand lower portion of the machine front panel 38, there are provided a cross key 23, an A-button 24, a B-button 25, a one deposited medal insertion switch 26, two deposited medals insertion switch 27, and three deposited medals insertion switch 28. The cross key 23 can be switch-operated in either of the four directions, namely, upward, downward, leftward and

rightward directions, and is utilized upon selecting information to be displayed on the liquid crystal display panel 39d through concurrent operation with A- and B-buttons. The deposited medal insertion switches 26-28 are used when one to three medals are bet on one game instead of medal insertion into the medal insertion slot 8 when the deposition amount display unit 16 displays the number of credited medals.

[0020] Below the reel display window unit 39, there are provided a deposited medal adjustment switch 29, a start lever 30 and stop buttons 31, 32 and 33, in this order from the left side in the figure. The deposited medal adjustment switch 29 is used for adjusting the medals credited within the machine. When the start lever 30 is operated, the reels 2-4 start rotating simultaneously. The stop buttons 31-33 are disposed corresponding to the respective reels 2-4. Each of buttons 31-33 is operatively activated when each of the reels 2-4 reaches a predetermined rotational speed, and stops rotation of the respective reels 2-4 in response to the player's operation.

[0021] A medal receiving tray 34 is provided at the front bottom of the slot machine 1. The medal receiving tray 34 serves to stock the medals paid out

from a medal payout opening 35. At the front top of the slot machine 1, a dividend display unit 36 is provided for displaying the number of medals to be paid out when a game is won.

5 [0022] Fig. 3 is a vertical cross-sectional view of the reel display window unit 39. Fig. 4 is an exploded perspective view of the reel display window unit 39. As shown in Fig. 3, the reel display window unit 39 is provided in front of the respective reels  
10 2, 3 and 4. As shown in Fig. 4, the reel display window unit 39 comprises a transparent acrylic plate 39a, a reel glass base 39b, a bezel metal frame 39c, a liquid crystal display panel 39d, a liquid crystal holder 39e, a diffusion sheet 39f, a light guiding plate 39g, a  
15 reflection sheet 39h, a backlight frame 39i and an antistatic sheet 39j, in this order from the near side of the machine.

[0023] As shown in Fig. 3, the reel display window unit 39 is fitted to the machine front panel 38 in such  
20 a manner that respective brackets 39ba provided to the reel glass base while protruding upward and downward thereof are screwed onto the rear of the machine front panel 38 via respective screws 39k. In this connection, the respective brackets 39ba provided to  
25 the reel glass base 39b are not shown in Fig. 4.

[0024] The liquid crystal display panel 39d is a

transparent electric display panel made of ITO or the like, which is disposed in front of the respective reels 2-4 to allow the same to be seen through the panel 39d. The rear side of the periphery of the display unit is held by a liquid crystal holder 39e. The light guiding plate 39g is made of a substantially light transparent resin panel and has a lens cut formed therein for guiding the light having entered the plate 39g from the upper and lower side faces thereof to the rear side of the liquid crystal panel 39d. Above and below the light guiding plate 39g, a pair of illumination devices 39m is provided for illuminating the liquid crystal display panel 39d along the upper and lower side faces of the light guiding plate 39g, respectively. The diffusion sheet 39f is made of a substantially light transparent resin sheet and serves to diffuse the light guided by the light guiding plate 39g to uniformize the light illuminated to the liquid crystal display panel 39d. The reflection sheet 39h is a sheet for reflecting the light, which has emitted from the illumination device 39m to the light guiding plate 39g, toward the liquid crystal display panel 39d side.

[0025] In the diffusion sheet 39f, the light guiding plate 39g, the reflection sheet 39h and the backlight frame 39i, there are provided openings 5a,

5b, 5c and 5d constituting a display window 5, openings 6a, 6b, 6c and 6d constituting a display window 6, and openings 7a, 7b, 7c and 7d constituting a display window 7. The openings 5a-5d, the openings 6a-6d and the openings 7a-7d are superposed to constitute a substantially light transparent area. The symbols drawn on reels 2, 3 and 4 can be seen through the substantially light transparent area from the outside.

[0026] The reel glass base 39b, the bezel metal frame 39c, the liquid crystal panel 39d, the liquid crystal holder 39e, the diffusion sheet 39f, the light guiding plate 39g, the reflection sheet 39h, the backlight frame 39i, the antistatic sheet 39j and the illumination device 39m constitute an electric display device, which is disposed in front of the reels 2-4 and allows the symbols drawn on reels 2-4 to be seen through the substantially light transparent area thereof.

[0027] The liquid crystal display panel 39d is held by the liquid crystal holder 39e to be integrated with the diffusion sheet 39f, the light guiding plate 39g and the reflection sheet 39h, the periphery of which is inserted into the bezel metal frame 39c. Through this insertion, the front side of the periphery of display unit of the liquid crystal

display panel 39d is held by the bezel metal frame 39c.

[0028] The liquid crystal display panel 39d, the liquid crystal holder 39e, the diffusion sheet 39f, the light guiding plate 39g and the reflection sheet 39h integrated by being fitted into the bezel metal frame 39c are further inserted in the reel glass base 39b at the circumference thereof to be supported by the reel glass base 39b in such a state that the front face of the display unit of the liquid crystal display panel 39 is opened. The transparent acrylic plate 39a is pressed to the front face of the reel glass base 39b by fitting the reel glass base 39b with a screw 39k to the front panel 38 of the machine to cover the opening of the front face of the display unit of the liquid crystal display panel 39.

[0029] The backlight frame 39i is made of a white resin plate and holds the bezel metal frame 39c, the liquid crystal display panel 39d, the liquid display holder 39e, the diffusion sheet 39f, the light guiding plate 39g and the reflection sheet 39h, which are supported by the reel glass base 39b, to the reel glass base 39b from behind of them. The antistatic sheet 39j is transparent and adhered to the back face of the backlight frame 39i with a double-sick tape, and covers the back face of the respective apertures 5d, 6d and 7d formed in the backlight frame 39i.



[0030] Fig. 5 is an enlarged perspective view of an illumination device 39m disposed along the lower side face of the light guiding plate 39g. The illumination device 39m being disposed along the upper side face of the light guiding plate 39g has the same configuration as the above illumination device.

[0031] As shown in this figure, each illumination device 39m comprises a plurality of high brightness LEDs 39m2 disposed on the upper end face of a board 39m1. The board 39m1 is shaped as an elongated plate, and a connector 39m3 is provided at one lengthwise end thereof to be used to connect a wiring for power supply. The respective high brightness LEDs 39m2 emit white light and are arrayed in a line along the lengthwise direction of the board 39m1 on the upper end face of the board 39m1. Respective illumination devices 39m are disposed along the upper and lower faces of the light guiding plate 39g while keeping the upper end face of the board 39m1 toward the light guiding plate 39g side to illuminate the light emitted from the high brightness LEDs 39m2 to the light guiding plate 39g. The emitted light is reflected from the reflection sheet 39h to the diffusion sheet 39f to be diffused, and then illuminates the liquid crystal display panel 39d from the rear side.

[0032] Fig. 6 shows symbol sequences drawn on the

outer periphery of the reels 2, 3 and 4. Each symbol sequence comprises an array of 21 symbols including a plurality of kinds. The symbol sequences correspond to the first, second and third reels 2, 3 and 4 from the left to the right in the figure in this order, respectively. Each of the symbols is assigned a code number out of "1" to "21". Each reel 2, 3 and 4 is rotationally driven to move the corresponding symbol sequence downward in the figure.

[0033] There are seven kinds of symbols, i.e. "Red 7" represented by a digit with oblique lines in a net; "Blue 7" represented by a digit with oblique lines from upper right to lower left; "BAR" represented by a pair of alphabetic letters BAR in two columns; "Watermelon" represented by a picture of a watermelon; "Bell" represented by of a picture of a bell; "Plum" represented by a picture of a plum; and "Cherry" represented by a picture of cherries.

[0034] Each of reels 2-4 is configured as a rotation reel unit shown in Fig. 7 and attached to a frame 41 via a bracket 42. Each of reels 2-4 comprises a reel drum having a reel band 44 affixed on its outer periphery. The symbol sequence described above is drawn on the outer periphery of the reel band 44. Each bracket 42 is provided with a stepping motor 45 adapted to rotationally drive the corresponding reel 2, 3 or

4.

[0035] The structure of respective reels 2-4 is shown in Fig. 8. In this figure, similar parts as in Fig. 7 are designated with the same reference signs and are not described herein. A lamp case 46 is provided inside the reel drum 43 behind the reel band 44. In the respective three compartments of the lamp case 46, back lamps 47a, 47b and 47c are installed. These back lamps 47a-47c are constituted of a white LED and attached to the back face of the lamp case 46. A photosensor 49 is also attached to the bracket 42. The photosensor 49 detects a shield 50 provided on the reel drum 43 passing over the photosensor 49 when the reel drum 43 rotates.

[0036] Each of back lamps 47a-47c is controllably lighted by a lamp drive circuit described later. Each of the lighted back lamps 47a-47c separately illuminates three symbols positioned in front of it out of the symbols drawn on the reel band 44 to project the respective three symbols onto the respective display windows 5-7.

[0037] Fig. 9 shows a table of winning symbol combinations predetermined in the slot machine 1 in accordance with the embodiment, which is shown on the payoff display unit 36 at the front top of the slot machine 1. In a ordinary game, when a combination of

symbols "Red 7" - "Red 7" - "Red 7", a combination of symbols "Blue 7" - "Blue 7" - "Blue 7", or a combination of symbols "BAR" - "BAR" - "BAR" is laid beneath an activated pay line, 15 medals are paid out, and then  
5 an R·B (Ordinary·Bonus) game is executed.

[0038] Further, in a ordinary game, when three identical symbols "Watermelon" or "Bell" are laid beneath an activated pay line, a small prize is won and 15 medals are paid out. Similarly, in a ordinary  
10 game, when a combination of symbols "Bell" - "Bell" - "Red 7", a combination of symbols "Bell" - "Bell" - "Blue 7", or a combination of symbols "Bell" - "Bell" - "BAR" is laid, a small prize is also won and 10 medals are paid out.

15 [0039] Furthermore, in a ordinary game, when three "Plum" symbols are laid beneath an activated pay line, then a player is entitled to a replay, i.e., the player can play an additional game without inserting a medal, although no medal is paid out. This combination of  
20 three "Plum" symbols is also a combination for occurring a JAC game winning in the JAC game being played in the course of a R·B game. The JAC game refers to a game to obtain a combination of "Plum" - "Plum" - "Plum" just beneath the center pay line L1 in the  
25 course of an R·B game.

[0040] Moreover, in a ordinary game, when one

"Cherry" symbol stops beneath one activated pay line in the first reel 3, a small prize is won and two medals are paid out, which is referred to as "two-medal cherry". During betting three medals, when one  
5 "Cherry" symbol stops beneath two activated pay lines, four medals are paid out, which is referred to as "four-medal cherry".

[0041] Figs. 10 and 11 show circuit configurations arranged on a main control board 61 and a sub-control  
10 board 62, respectively, for controlling the game executing operations of the slot machine 1 described above.

[0042] The control unit of the main control board 61 shown in Fig. 9 comprises a microcomputer 63 as its  
15 major component and additionally a circuit for a random number sampling. The microcomputer 63 comprises a main CPU (central processing unit) 64 for performing control operations according to a preset program, a program ROM (read only memory) 65 serving  
20 as program storage means, and a backup-capable control RAM (random access memory) 66. To the main CPU 64, a clock pulse generation circuit 67 and a frequency divider 68 for generating reference clock pulses, a random number generator 69 for generating a certain  
25 range of random numbers, and a random number sampling circuit 70 for specifying one of the generated random

numbers. In addition, an I/O port 71 is connected for communicating signals with peripheral devices (actuators) described later. The ROM 65 has a storage unit sectioned so as to separately store a winning probability table, a symbol table, a winning symbol combination table and a sequence program.

[0043] Examples of principal actuators whose operation is controlled by a control signal from the microcomputer 63 include the stepping motors 45 for rotationally driving the respective reels 2, 3 and 4, various lamps (game medal insertion amount indicator lamps 13-15, a start lamp 17, a WIN lamp 19 and a insertion lamp 21), various display units (a deposition amount display unit 16, various indicators 9-12, a bonus count display unit 18 and a payoff amount display unit 20) and a hopper 72 for containing medals. These are driven by a motor drive circuit 73, an individual lamp drive circuit 74, an individual display unit drive circuit 75 and a hopper drive circuit 76, respectively. These drive circuits 73-76 are connected to the CPU 64 via the I/O port 71 of the microcomputer 63.

[0044] Examples of major input signal generation means for generating input signals required for the microcomputer 63 to produce control signals include an inserted medal sensor 8S for detecting a medal

inserted through the medal insertion slot 8, a start switch 30S for detecting an operation of the start lever 30, the above-described deposited medal insertion switches 26-28 and the deposited medal adjustment switch 29. In addition, there is a reel position detection circuit 77 for detecting the rotational position of respective reels 2, 3 and 4 upon receipt of an output pulse signal from the photosensor 49. The photosensor 49 is included in the driving mechanism of each of reels 2-4 and not shown in this figure.

[0045] The reel position detection circuit 77 counts the number of driving pulses supplied to each of stepping motors 45 after the reels 2-4 have started rotating, and writes these count values to a predetermined area in the RAM 66. Accordingly, the RAM 66 stores the count value corresponding to the rotational position within a range of one rotation for respective reels 2-4. The photosensor 49 detects the shield plate 50 for each rotation of the reels 2-4 to generate a reset pulse. This reset pulse is applied to the CPU 64 via the reel position detection circuit 77 and causes the count value of driving pulses counted in the RAM 66 to be cleared to "0". This clearing procedure eliminates the misalignment occurring between the moving display of each symbol and the

rotation of each stepping motor 45 every rotation.

[0046] Examples of the input signal generation means described above also include a reel stop signal circuit 78 for stopping a corresponding reel when a stop button 31, 32 or 33 is pushed, a medal detection unit 72S for counting the number of medals to be paid out from the hopper 72, and a payout completion signal generation circuit not shown. The payout completion signal generation circuit generates a signal indicating the completion of medal payout when the count value of medals actually paid out inputted from the medal detection unit 72S reaches the payoff amount data represented by the count signal inputted from the display unit drive circuit 75. Each circuit constituting these input signal generation means is also connected to the main CPU 64 via the I/O port 71.

[0047] To the I/O port 71, a sub-control unit communication port 79 is connected. The microcomputer 63 delivers a signal to the sub-control board 62 via the sub-control unit communication port 79. The sub-control board 62 shown in Fig. 11 is provided with a main control unit communication port 80 for receiving this signal. Communication between the sub-control unit communication port 79 and the main control unit communication port 80 is preformed only in one direction, namely, from the sub-control



unit communication port 79 to the main control unit communication port 80. In the embodiment, the signal delivered from the sub-control unit communication port 79 to the main control unit communication port 80 is composed of a set including a command type representing its control type in 7-bit length and a parameter representing the content of the command in 8-bit or 24-bit length.

[0048] The control unit in the sub-control board 62 comprises a microcomputer 81 as its major component and additionally a circuit for sampling random numbers. The microcomputer 81 comprises, as with the microcomputer 63 in the main control board 61, a sub-CPU 82 for performing control operations according to a preset program, a program ROM 83 serving as program storage means, and a backup-capable control RAM 84. To the sub-CPU 82, a clock pulse generation circuit 85 and a frequency divider 86 for generating reference clock pulses are also connected. In addition, an I/O port 87 is connected for communicating signals with the main control unit communication port 80 and the actuators described below. The sub-CPU 82 calculates data required to display gaming machine data on the liquid crystal panel 39d on the basis of the command transmitted from the main control board 61 for each game and updates

data stored in the control RAM 84 to the data calculated for each game.

[0049] Examples of actuators whose operation is controlled by a control signal from the microcomputer 81 include the high brightness LEDs 39m2 constituting the above-described illumination device 39m and the reel back lamps 47a, 47b and 47c housed in the reels 2-4. The lighting of the LEDs 39m2 is controlled by a driving signal from a LED drive circuit 98 connected to the I/O port 87. The lighting of the back lamps 47a-47c is controlled by a driving signal from a lamp drive circuit 89 connected to the I/O port 87. As input signal generation means for generating input signals required for the microcomputer 81 to produce control signals, there are the cross key 23, A-button 24 and B-button 25. Further, a game status monitoring timer 97 is connected to the I/O port 87. This timer 97 is set by the sub-CPU 82 at the time when a game is started, and measures the period elapsed since the start of the game.

[0050] An image control IC (integrated circuit) 90 and a sound source IC 91 are also connected to the I/O 87. To the image control IC 90, a character ROM 92 for storing character data and a video RAM 93 serving as a memory for color display representation are connected. The image control IC 90 displays an

image on the liquid crystal display panel 39d of the reel display window unit 39 under the control of the microcomputer 81. The microcomputer 81 fetches information such as the current game status and the type of winning flag from the main control board 61 via the main control unit communication port 80 and selects an image effect pattern to be displayed on the basis of the fetched game status and winning flag. Then it controls the image control IC 90 to make the liquid crystal panel 39d display the selected pattern. It is also possible to allow the liquid crystal panel 39d to display information desired by a player through the operation of the cross key 23, A-button 24 and B-button 25.

[0051] To the sound source IC 91, a sound ROM 94, in which sound data has been stored, is connected. The sound source IC 91 makes a speaker 96 emit a sound via a power amplifier 95 under the control of the microcomputer 81. The microcomputer 81 controls the sound source IC 91 and the power amplifier 95 to make the speaker 96 emit such sound effects as a medal insertion sound, a start lever operation sound, a stop button operation sound and a game sound during a bonus game, in accordance with the instructions inputted from the main control board 61 via the main control unit communication port 80.

[0052] In the slot machine 1 in accordance with the embodiment having the configuration described above, when a player operates the start lever 30, the start switch 30S is turned on. This ON signal is detected by the main CPU 64 via the I/O port 71. The main CPU 64 then controls the motor drive circuit 73 to drive the stepping motors 45, causing rotation of respective reels 2-4. In conjunction with the rotation, the main CPU 64 performs the probability lottery procedure. By referring to a probability lottery table stored in the program ROM 65, a lottery for an internal winning mode is performed. The type of the internal winning mode thus drawn and the game status at the time are transmitted to the sub-control board 62 via the sub-control unit communication port 79.

[0053] When respective reels 2-4 rotate, a line of moving symbols is variably displayed in each of window 5-7. The player seeks a good timing for operating each of stop buttons 31-33 while observing this variable display at the respective display windows 5-7 and performs push operation for each of stop buttons 31-33 at a suitable timing. This operation for respective stop buttons 31-33 is detected by the main CPU 64 via the reel stop signal circuit 78. When detected, the supply of driving

pulses to respective stepping motors 45 is stopped by the control of the main CPU 64. When the driving pulses to respective stepping motors 45 is stopped, the respective reels 2-4 stop rotating, and the symbols corresponding to the above-described operation timing for each of stop buttons 31-33 are stationarily displayed inside the respective windows 5-7. On this occasion, when the combination of symbols stationarily displayed inside the respective windows 5-7 coincides with a predetermined combination of symbols shown in the payoff table, winning occurs. When the winning occurs, the main CPU 64 controls the hopper drive circuit 76 to drive the hopper 72 and a predetermined number of medals are paid out from the payout opening 35 into the receiving tray 34.

[0054] The type of an internal winning mode and the game status transmitted from the sub-control unit communication port 79 to the sub-control board 62 is received by the sub-CPU 82 via the main control unit communication port 80 of the sub-control board 62. During the slot machine game described above, effects of the slot machine game are performed under the control of the sub-CPU 82 which has detected the type of internal winning mode and the game status, such as blinking reel back lamps 47a, 47b and 47c housed in

the reels 2-4.

[0055] Further, in the embodiment, effects in accordance with the type of the internal winning mode and the game status are also displayed under the control of the sub-CPU 82 on the liquid crystal display 39d provided at the reel display window unit 39 in front of the respective reels 2-4. During the slot machine game described above, the sub-CPU 82 controls the LED drive circuit 98 to light the high brightness LEDs 39m2. The light emitted from the high brightness LEDs 39m2 enters the light guiding plate 39g through the upper and lower side faces of the plate 39g and then exits the light guiding panel 39g from its one end face on the side of liquid crystal panel 39d. The emitted light illuminates the liquid crystal panel 39d from back face side to make the image displayed on the liquid crystal display panel 39d visible.

[0056] In the slot machine 1 in accordance with the embodiment, since the high brightness LEDs 39m2 constituting the illumination device 39m is lighted merely through application of DC current, an inverter circuit is not necessary as opposed to a conventional cold-cathode tube. Therefore, it is possible to prevent an image displayed on the liquid crystal panel 39d from being disturbed by the noise generated from an inverter circuit and reduce the manufacture cost

of the slot machine 1. In addition, since the lighting of the high brightness LEDs 39m2 can be achieved without using a transformer as opposed to a conventional cold-cathode tube, no variation occurs in voltage applied to the high brightness LEDs 39ms among respective members of the slot machine 1 due to the coil loss of the transformer. Therefore, variation in the brilliance among the illuminated liquid crystal panels 39d of respective members of the slot machine 1 can be avoided. Furthermore, the lightness adjustment of the illumination due to the high brightness LEDs 39m2 can be easily achieved by merely adjusting the amount of current supplied to the high brightness LEDs 39m2 via variable resistance or the like.

[0057] In the slot machine 1 in accordance with the embodiment, the amount of light emitted from the illumination device 39m can be adjusted by adjusting the amount of current supplied to each of the LEDs 39m2 arranged in a series on the board 39m1 and increasing/decreasing the number of the LEDs 39m2 to be supplied with power. Therefore, it is possible to adjust the overall light and shade of the liquid crystal panel 39d constituting the electric display device.

[0058] With regard to the above embodiment, the

case where the illumination devices 39m are provided along the upper and lower side faces of the light guiding plate 39g, respectively, is described. However, it is also possible to provide the illumination devices 39m along the left and right side faces of the light guiding plate 39g, respectively, and guide the illumination light emitted from the illumination device 39m and entered the light guiding plate 39g through the left and right side faces thereof to the back face side of the liquid crystal display panel 39d.

[0059] A second embodiment will now be described wherein the gaming machine in accordance with this invention is applied to a slot machine.

[0060] The configuration of the slot machine in accordance with the embodiment is the same as the slot machine according to the first embodiment except the structure of the reel display window unit 39. Fig. 12 is a vertical cross-sectional view of the reel display window unit 39 in the slot machine in accordance with the second embodiment. Fig. 13 is an exploded perspective view of the reel display window unit 39. In Figs. 12 and 13, the parts same as those in Figs. 3 and 4 will be given with the same reference characters and the descriptions thereof will be omitted.



[0061] As shown in Fig. 13, the reel display window unit 39 comprises a protective frame 39p instead of, and disposed at the same location as, the light guiding plate 39g and illumination device 39m in the reel display window unit 39 in accordance with the first embodiment and an illumination device 39q instead of, and at the same location as, the reflection sheet h, and is attached to the machine front panel 38 as shown in Fig. 12. The protective frame 39p serves to maintain distance between the illumination device 39q and the diffusion sheet f in such a manner that the red, green and blue lights emitted from the high brightness LEDs 39q2, respectively, of the illumination device described later are mixed to illuminate the diffusion sheet 39f as a white light.

[0062] In the embodiment, the electric display device comprises a reel glass base 39b, a bezel metal frame 39c, a liquid crystal display panel 39d, a liquid crystal holder 39e, a diffusion sheet 39f, a backlight frame 39i, an antistatic sheet 39j, a protective frame 39p and an illumination device 39q.

[0063] Fig. 14 is an exploded perspective view of the illumination device 39q.

[0064] The illumination device 39q comprises the high brightness LEDs 39q2 arranged in a matrix on one face of a plate-shaped board 39q1, excluding the

substantially light transparent area, having a substantially same appearance as the light guiding plate 39g of the above first embodiment. In the board 39q1, an aperture 5e constituting a display window 5, an aperture 6e constituting a display window 6, and an aperture 7e constituting a display window 7 are formed to constitute substantially light transparent areas together with the apertures 5a and 5d, the apertures 6a and 6d, and the apertures 7a and 7d, respectively. The illumination device 39q is disposed such that the high brightness LEDs 39q2 are arranged on its one surface oriented toward the back face side of the liquid crystal display panel 39d.

[0065] According to this configuration, the light emitted from the high brightness LEDs 39q2 of the illumination device 39q irradiates the diffusion sheet 39f as white light resulted from the mixture of the red, green and blue light, and illuminates the back face of the liquid crystal display panel 39d after being diffused at the diffusion sheet 39f.

[0066] Therefore, according to the slot machine of the embodiment, since the light emitted from the high brightness LEDs 39q2 illuminates directly the liquid crystal display panel 39d, the illumination of the liquid crystal display panel 39d can be achieved without using the light guiding plate 39g. Therefore,

the structure of the electric display device can be simplified. Further, through increasing/decreasing the amount of current to be supplied to each of a number of high brightness LEDs 39q2 arranged on one surface of the board 39q1, the amount of the illumination light emitted from the illumination device 39q can be adjusted over a wide range. Therefore, as opposed to a conventional slot machine requiring a plurality of cold-cathode tubes arranged in thickness direction, it is possible to increase significantly the amount of the illumination light while keeping the thickness of the illumination device 39q constant. Accordingly, even when the liquid crystal display panel 39d is of a large size, distance between the reels 2-4 and the liquid crystal display panel 39d can be maintained constant. As a result, even when a large-size liquid crystal display panel is used, the misalignment between the symbols drawn on the outer periphery of reels 2-4 and the image displayed on the liquid crystal display panel 39d occurring depending on the player's viewing angle can be suppressed to be small, and effects can be prevented from being impaired. Further, by selecting the lighting area of the respective high brightness LEDs 39q2 arranged on the board 39q1 in a matrix or by adjusting the amount of current supplied to the high brightness LEDs 39q2 in

a specified area, it is possible to selectively illuminate a specified area within the liquid crystal display panel 39d or adjust the lightness of the specified area. As a result, display mode for effect display as well as information display by the electric display device can be diversified. Further, the amount of power consumption of the illumination device 39q can be reduced.

[0067] In the embodiment described above, an illumination means is constituted by disposing the high brightness LEDs 39q2 on the board 39q1. However, this invention is not limited thereto. For example, an illumination means may be constituted by using the backlight frame 39i as the board 39q1, and arranging the high brightness LEDs 39q2 in a matrix on the front face of the backlight frame 39i.

[0068] In each of the above embodiments, the number of high brightness LEDs 39m2 and 39q2 arranged on the boards 39m1 and 39q1 can be appropriately altered in accordance with the amount of light emitted from the respective high brightness LEDs 39m2 and 39q2 or the size of the liquid crystal display panel 39d. As the boards 39m1 and 39q1 constituting the illumination devices 39m and 39q, respectively, not only the merely plate-shaped boards but also, for example, FPC (flexible printed circuit board) may be

used. Further, in the above respective embodiments, the LED drive circuit 98 is arranged on the sub-control board 62. However, a constitution in which the LED drive circuit 98 is arranged on the main control board 61 is also allowed. Moreover, a constitution is also possible in which only the LED drive circuit 98 is unitized and power is supplied to the LED drive circuit 98 directly from a power source circuit.

[0069] In each of the above described embodiments, this invention is applied to the liquid crystal display device provided in a slot machine. However, this invention is not limited to the case but may also be applied to the liquid crystal display device provided in another type of gaming machines such as, for example, a pachinko gaming machine.

[0070] As described above, according to this invention, the electric display panel is illuminated by LEDs to make the image displayed on the electric display panel visible. Since LEDs are lighted merely through application of DC current, no inverter circuit is necessary. Therefore, it is possible to prevent the image displayed on the electric display panel from being disturbed by noise, enhance the quality of the image displayed on the electric display device and reduce the manufacture cost of a gaming machine. Further, since the lighting of LEDs requires no

transformer, variations in voltage applied to an illumination means due to coil loss can be avoided among respective members of a gaming machine. Accordingly, variations in lightness of the illumination of the liquid crystal display panel can be prevented. Moreover, the lightness of the illumination can be easily adjusted by merely adjusting the amount of current supplied to LEDs by using variable resistance or the like.

[0071]

Although only some exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention.

[0072] This application is related to co-pending U.S. patent applications entitled "GAMING MACHINE" referred to as Attorney Docket No. SHO-0019, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0020, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0021, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0022, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0023, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0024, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0025, "GAMING MACHINE" referred to as Attorney Docket No. SHO-0026, "GAMING MACHINE" referred to as Attorney

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Docket No. SHO-0052, "MOTOR STOP CONTROL DEVICE" referred to

as Attorney Docket No. SHO-0053, "GAMING MACHINE" referred to as  
Attorney Docket No. SHO-0054, "GAMING MACHINE" referred to as  
Attorney Docket No. SHO-0055, "GAMING MACHINE" referred to as  
Attorney Docket No. SHO-0056, and "GAMING MACHINE" referred to  
5 as Attorney Docket No. SHO-0057, respectively, all the applications  
being filed on October 31, 2003 herewith. The co-pending applications  
including specifications, drawings and claims are expressly  
incorporated herein by reference in their entirety.